



**Monsanto  
Company**

**LASAGNA™**

## Technology Need:

Contamination in low-permeability soils poses a significant technical challenge to in situ remediation. Poor accessibility to the contaminants and difficulty in delivery of treatment reagents have rendered existing in situ treatments, such as bioremediation, vapor extraction, and pump and treat, rather ineffective when applied to low-permeability soils present at many contaminated sites. A technology is needed for the in situ remediation of low-permeability soils.

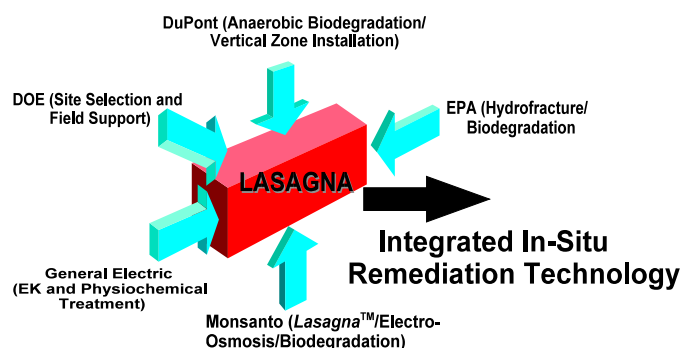
## Technology Description:

Lasagna™ is an integrated, in situ remediation technology developed by an industrial consortium consisting of Monsanto, E.I. DuPont de Nemours & Co., Inc. (DuPont), and General Electric, with participation from the Department of Energy (DOE) Office of Environmental Management, Office of Science and Technology (EM-50), and the Environmental Protection Agency (EPA) Office of Research and Development. Lasagna™ remediates soils and soil pore water contaminated with soluble organic compounds. Lasagna™ is especially suited to sites with low permeability soils where electroosmosis can move water faster and more uniformly than hydraulic methods, with very low power consumption.

The process uses electrokinetics to move contaminants in soil pore water into treatment zones where the contaminants can be captured or decomposed. Initial focus was on trichloroethylene (TCE), a major contaminant at many DOE and industrial sites. Both vertical and horizontal configurations have been conceptualized, but fieldwork to date is more advanced for the vertical configuration.

Major features of the technology include:

- ▶ Electrodes energized by direct current, cause water and soluble contaminants to move into or through the treatment zones and also heats the soil
- ▶ Treatment zones containing reagents decompose the soluble organic contaminants or adsorb contaminants for immobilization or subsequent removal and disposal
- ▶ A water management system recycles the water that accumulates at the cathode (high pH) back to the anode (low pH) for acid-base neutralization. Alternatively, electrode polarity can be reversed periodically to reverse electroosmotic flow and neutralize pH.



## Benefits:

- ▶ Treatment of organic and inorganic contamination, as well as mixed wastes
- ▶ Especially suited to sites with low permeability soils
- ▶ Reduces risk to personnel from exposure to hazardous contaminants
- ▶ Greatly reduced environmental impacts
- ▶ Compared to a number of benchmarked alternatives,

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Lasagna™ has similar per unit costs (\$40-60/cubic yard over a 3-year treatment period) but works up to 10 times faster.

- ▶Minimal waste generation
- ▶Increased treatment flexibility
- ▶Broad application for a wide range of sites and contaminants
- ▶Could be a large benefit to areas that have contaminants which are acting as long-term sources for contaminant plumes

### Status and Accomplishments:

This project was completed in May 1996. A proof-of-concept field demonstration was conducted at the Paducah Gaseous Diffusion Plant (PGDP) in Paducah, Kentucky from January 1995 through May 1995. This experiment tested the combination of electro-osmosis and in situ sorption in the treatment zones.

The Lasagna™ technology was deployed at the PGDP Solid Waste Management Unit 91 in the Fall of 1999 for treatment of Trichloroethylene (TCE) contaminated soil. The cleanup was completed by the Spring of 2002. The Lasagna™ process was successful in removing the TCE from the soil before it could get to the groundwater.



**Electrode Array Connections at Demonstration Site.**

Monsanto has also completed the Rapid Commercialization Initiative (RCI) - a Cooperative Program supported by DoD, Commerce, EPA, and State Regulators, as well as DOE. Two patents covering the technology have been granted to Monsanto, and the term Lasagna™ has also been trademarked by Monsanto.

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### Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 4  
<http://ost.em.doe.gov/tms>

The National Energy Technology Laboratory Internet address is <http://www.netl.doe.gov>

An Innovative Technology Summary Report (ITSR) for Lasagna™ may be viewed at <http://www.osti.gov/servlets/purl/7441-0W44ov/webviewable/7441.pdf>

The Monsanto Company's Website is located at <http://www.monsanto.com/monsanto/default.htm>